NL spray drift research, DRT classification, use in regulation and authorisation of PPP in fruit crops

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Overview

- Spray drift in NL fruit crop spraying
- Laboratory measurements nozzles – DRN classification
- Field measurements spray drift – DRT classification
- Spray technology in NL regulation and authorisation procedure –risk assessment
- Efficiency of orchard sprayers – improved spray deposition
- Discussion

NL – flat area with dense surface water systems

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legislation and crop protection products in the Netherlands

- Multi Year Crop Protection Plan (1991-2000)
  - 90% drift reduction, 50% use reduction
- Water Pollution Act (2000 onward)
  - 90% DRN + one-sided spraying last row + 3 m buffer zone
- Sustainable Crop Protection (2001-2010)
- Sustainable Crop Protection II – NAP (2013-2023), Activity Decree
  - 75% DRT + + 4.5 m buffer zone (all fields 2018 onward)
  - 90% DRT + 3.0 m buffer zone / IPM
- Vision 2030: no emission to environment (>95% DRT)
- Crop Protection and Biocide Act

spray drift (ISO 22866)

Spray drift is the quantity of plant protection product that is carried out of the sprayed (treated) area by the action of air currents

during the application process

What is the amount of spray drift coming out of an orchard during application of PPP?

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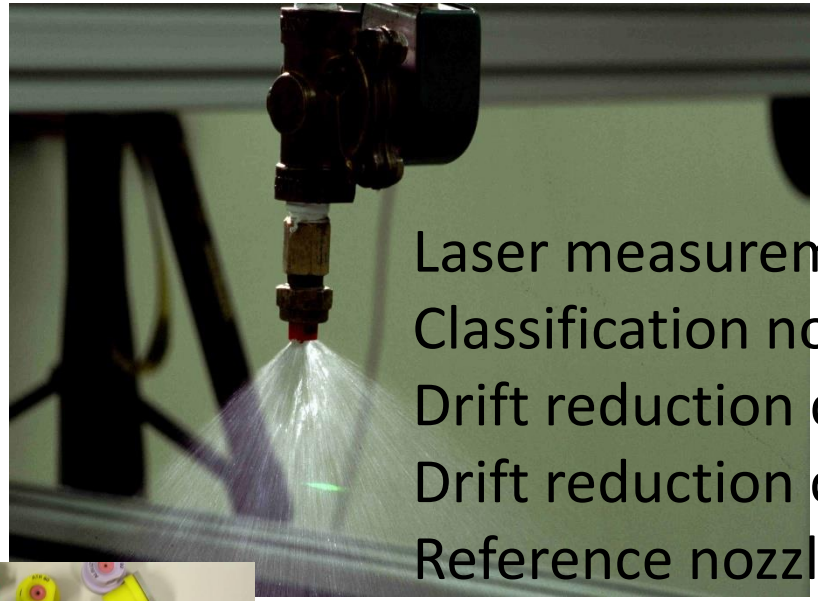
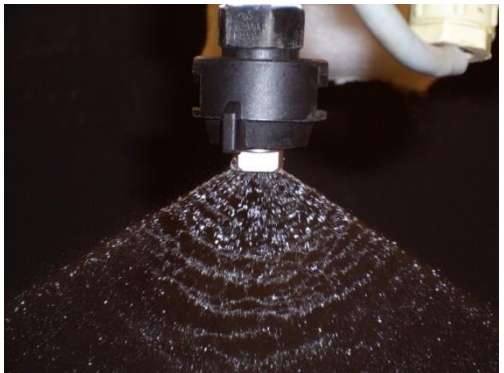
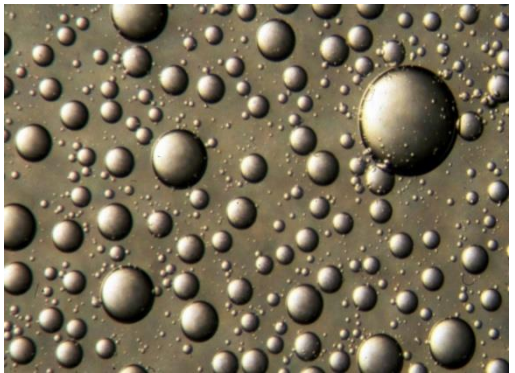
nozzle classification



Laser measurements in the laboratory
Classification nozzle-pressure combinations
Drift reduction classes 50, 75, 90, 95 %
Drift reduction classes based on V100
Reference nozzle Albuz ATR Lilac @ 7 bar





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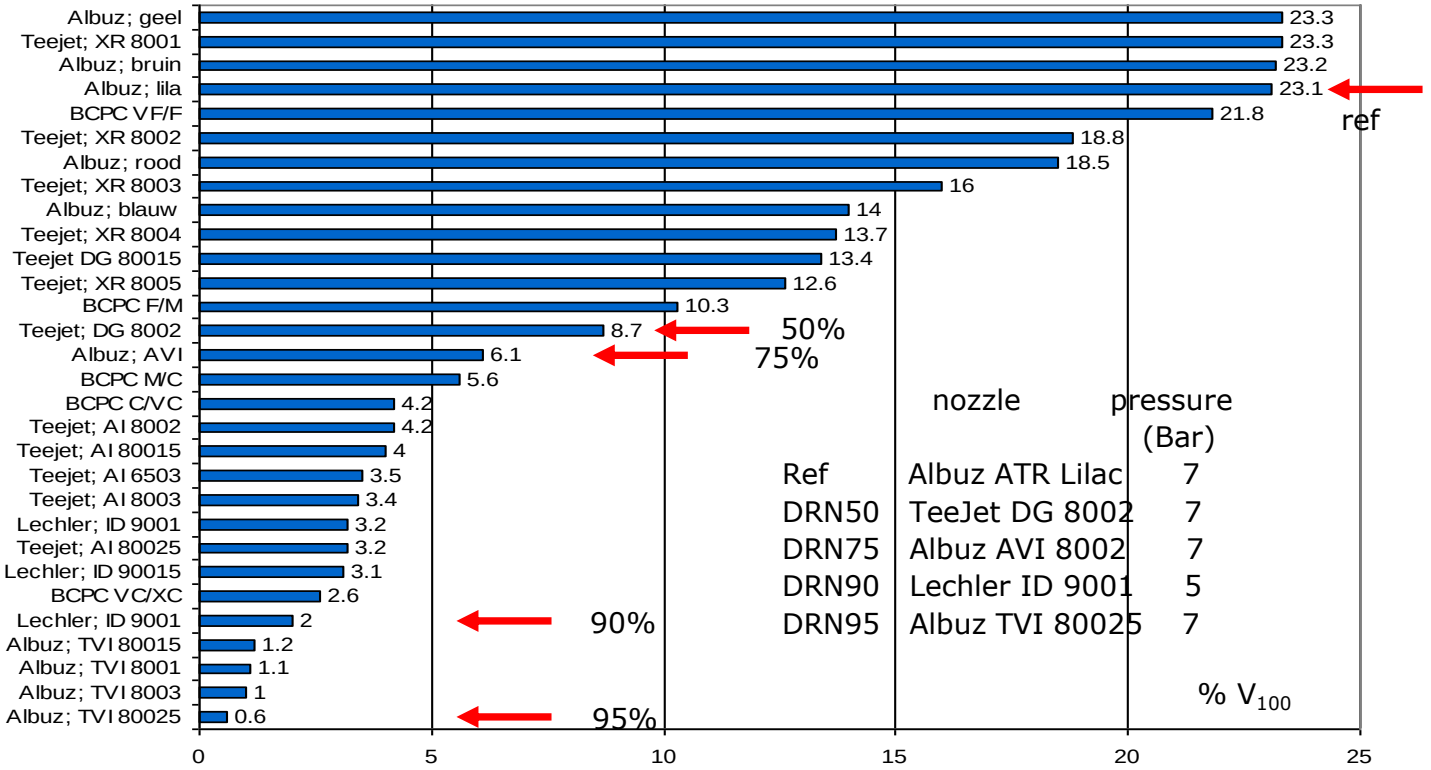
Drop size measurements spray nozzles



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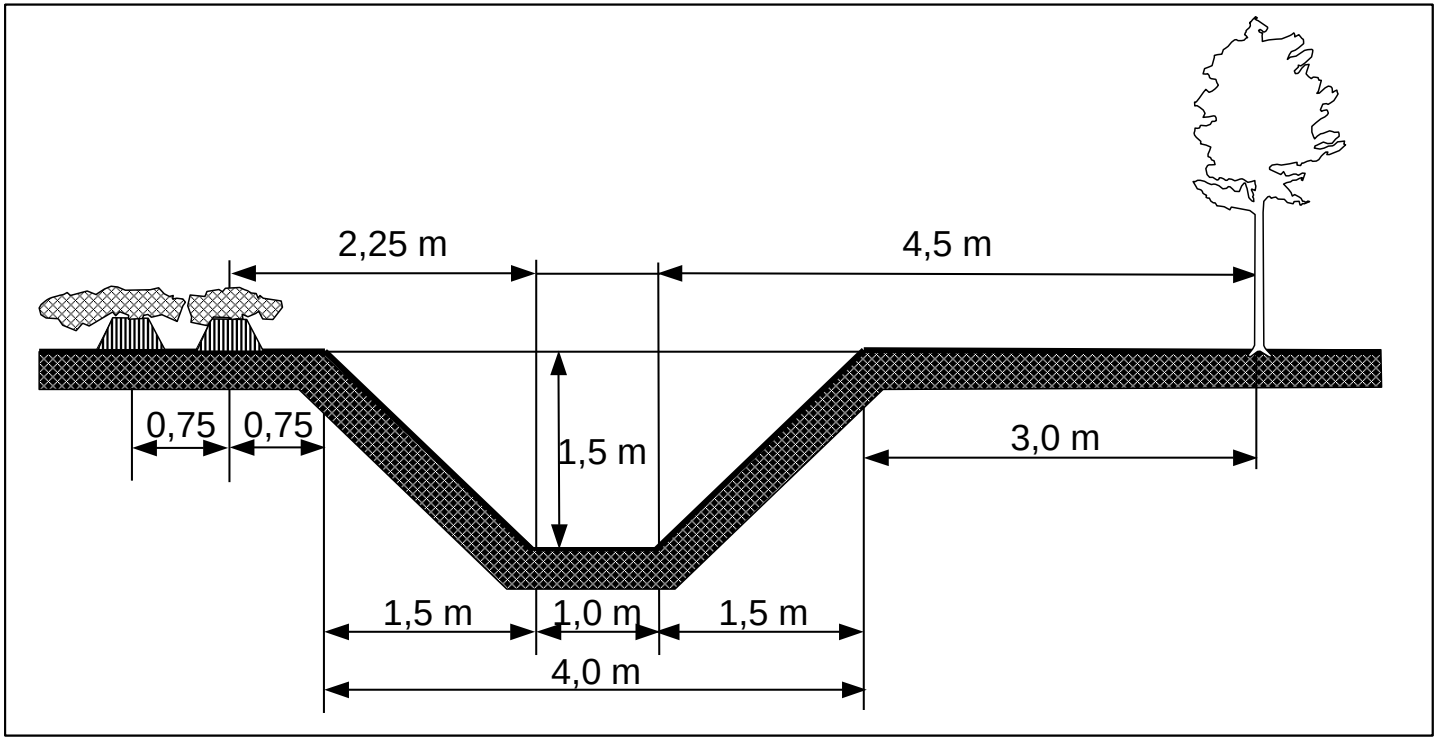
Spray drift measurement in the field (2018)

Comparative measurement with reference sprayer
Full leaf stage trees
Spray >20 m field edge, measure downwind to field/orchard
Wind direction +/- 30° rectangular to tree row
Measuring protocol NL-TCT, following ISO22866
Classify drift reduction based on at least 8 repetitions

Reference: cross-flow fan sprayer (Munckhof)

- Albuz ATR Lilac hollow cone nozzles at 7 bar spray pressure; Very Fine spray quality
- PTO 540 rpm
- Air assistance; high max 21 m/s
- Driving speed 6.4 km/h
- Spray volume 200 l/ha

Schematic layout of ditch dimensions and position NL evaluation zone for spray drift reduction



[Huijsmans et al.., 1997]

Fruit crop spraying in The Netherlands

drift reducing technology in fruit growing

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Classified drift reducing technology (DRT)
NL- orchard (3 m crop-free zone)

Drift reduction classes	Spray drift reducing technology in drift reduction class
50%	50% drift reducing nozzle types + one-sided outside row; sensor sprayer + standard nozzles; reflection shield sprayer + standard nozzles; Wanner cross-flow +reflection shield + standard nozzles.
75%	75% drift reducing nozzle types+ one-sided outside row; tunnel sprayer + standard nozzles; KWH 3-row sprayer + standard nozzles; Munckhof 3-row sprayer + standard nozzles + closure outside air outlet edge of field; HSS-CF Drift Control + AWC + 50% DRN + fan max 1800rpm + one-sided outside row.

Classified drift reducing technology (DRT)
NL- orchard (3 m crop-free zone)

Drift reduction classes	Spray drift reducing technology in drift reduction class
90%	90% drift reducing nozzle types + one-sided outside row; KWH Mistral VLBS 540 rpm PTO + 90% drift reducing nozzle; H.S.S. CF + H.S.S. Drift Control + DRN 90% + low air assistance (1800 rpm fan) HSS-CF Drift Control + AWC + 50% DRN + fan max 1400rpm + one-sided outside row
95%	90% drift reducing nozzle types + one-sided outside row + low air assistance; 95% drift reducing nozzle types+ one-sided outside row + 4.5 m crop-free zone; Wanner cross-flow +reflection shield + 75% drift reducing nozzles; KWH 3-row sprayer + 90% drift reducing nozzles + VLOS; KWH Mistral VLBS 400 rpm PTO + 90% drift reducing nozzles; Munckhof 3-row sprayer + 90% DRN + closure outside air outlet edge of field; H.S.S. CF + H.S.S. Drift Control + H.S.S. AWC (Automatic Wind Control) + automatic angling spouts + DRN 90% + low air assistance (1800 rpm fan) + one-sided outside row;

Classified drift reducing technology
NL- orchard (3 m crop-free zone)

DRT	Spray drift reducing technology in drift reduction class
97.5%	KWH 3-row sprayer + VLOS + 90% drift reducing nozzles; KWH 3-row sprayer + 90% drift reducing nozzles + variable air assistance outside 6 rows; KWH Mistral VLBS 300 rpm PTO + 90% drift reducing nozzles+ one-sided outside row; Munckhof 3 row sprayer VARIMAS + 90% DRN+ reduced air assistance (400 rpm) + variable air assistance outside 6 rows; Munckhof CF-VARIMAS + 90% DRN+ reduced air assistance (300 rpm) + variable air setting edge field rows+ one-sided outside row; Lochmann-vdLinden CF 90% drift reducing nozzles + reduced air assistance (300 rpm) + variable air assistance outside 3 rows; H.S.S. CF + H.S.S. Drift Control + DRN 90% + low air assistance (1400 rpm fan) + one-sided outside row; H.S.S. CF + H.S.S. Drift Control + AWC + DRN 90% + low air assistance (1400 rpm fan) + one-sided outside row; Wanner NTR20 cross-flow +reflection shield + 75% DRN + CLRS + reduced air assistance 700 rpm;

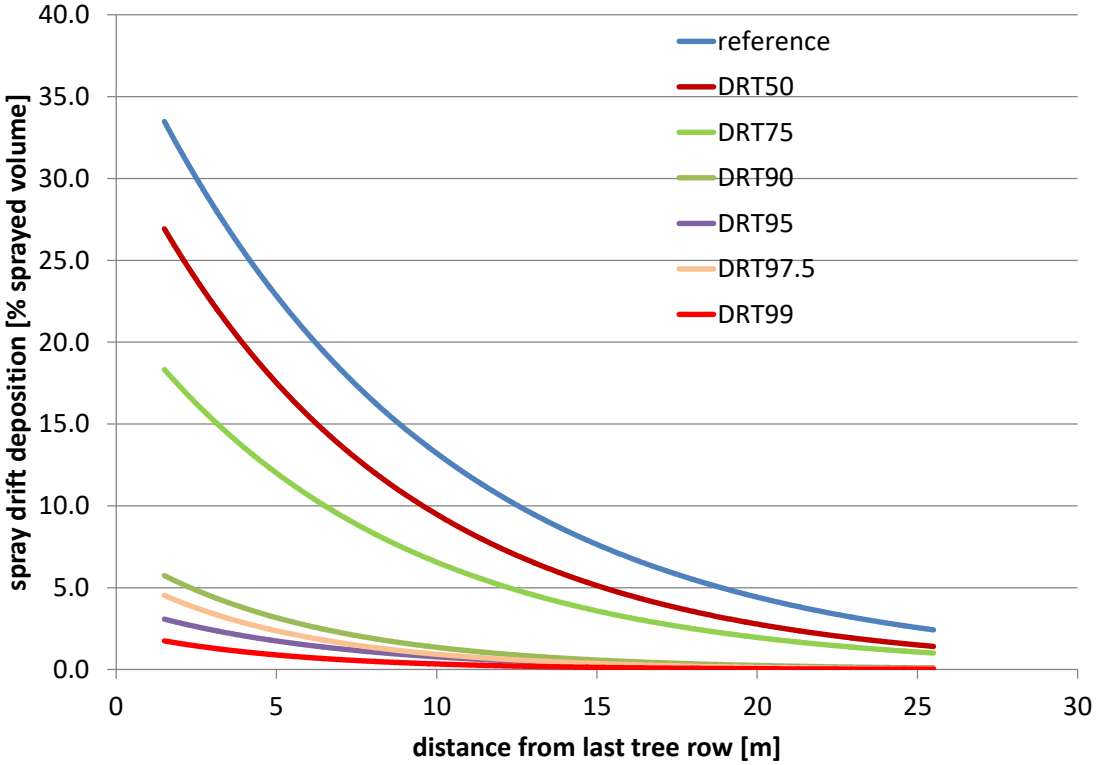
Classified drift reducing technology
NL- orchard (3 m crop-free zone)

Drift reduction classes	Spray drift reducing technology in drift reduction class
99%	KWH 3-row sprayer + 90% drift reducing nozzles + reduced variable air assistance (400 rpm PTO) + variable air assistance outside 6 rows; Munckhof 3 row sprayer VARIMAS + Endrow setting+ 90% drift reducing nozzles + reduced air assistance (400 rpm PTO); Munckhof CF-VARIMAS + 95% DRN+ reduced air assistance (300 rpm PTO) + Endrow setting + one-sided outside row; H.S.S. CF + H.S.S. ISA + 90% DRN + low air assistance (1400 rpm fan) + one-sided outside row; Lochmann-NL CF 90% DRN + reduced air assistance (300 rpm PTO) + variable air assistance outside 3 rows; Lochmann two-row tunnel +90% drift reducing nozzles.

Spray drift and drift reduction in the Netherlands

- 2018 onward: DRT75 obligatory on all fields; with along water ways DRT75 + 4.5 m cfbz and DRT90 + 3 m cfbz
- Further label restrictions: depending on toxicity of product.
- Classified drift reducing techniques (DRT) for orchards
  - DRT: (50%,) 75%, 90%, 95%, 97.5%, 99%.
- Spray drift reducing technology in drift reduction classes
  - Combination of measures e.g.:
    - Nozzles + one sided spraying last row.
    - Nozzles + specific sprayer type and configurations.

Spray drift deposition downwind of sprayed orchard for different DRT classes at dormant growth stage



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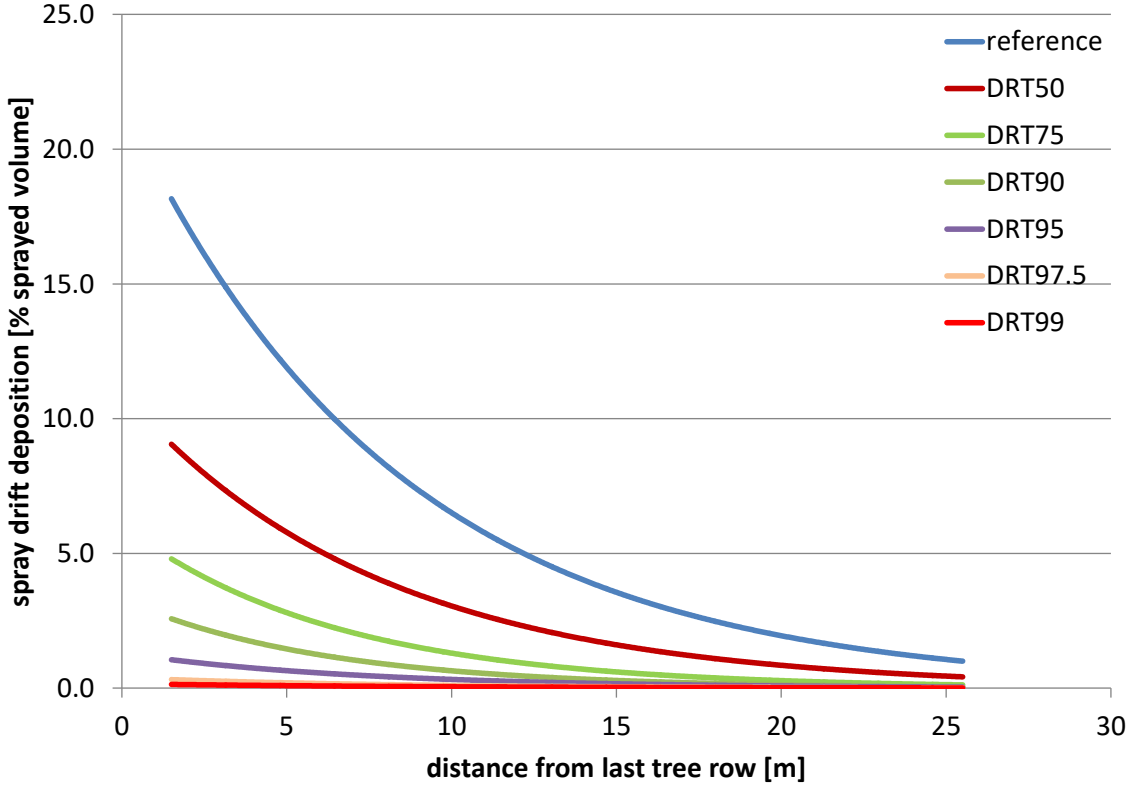
Spray drift deposition downwind of sprayed orchard for different DRT classes at full leaf growth stage



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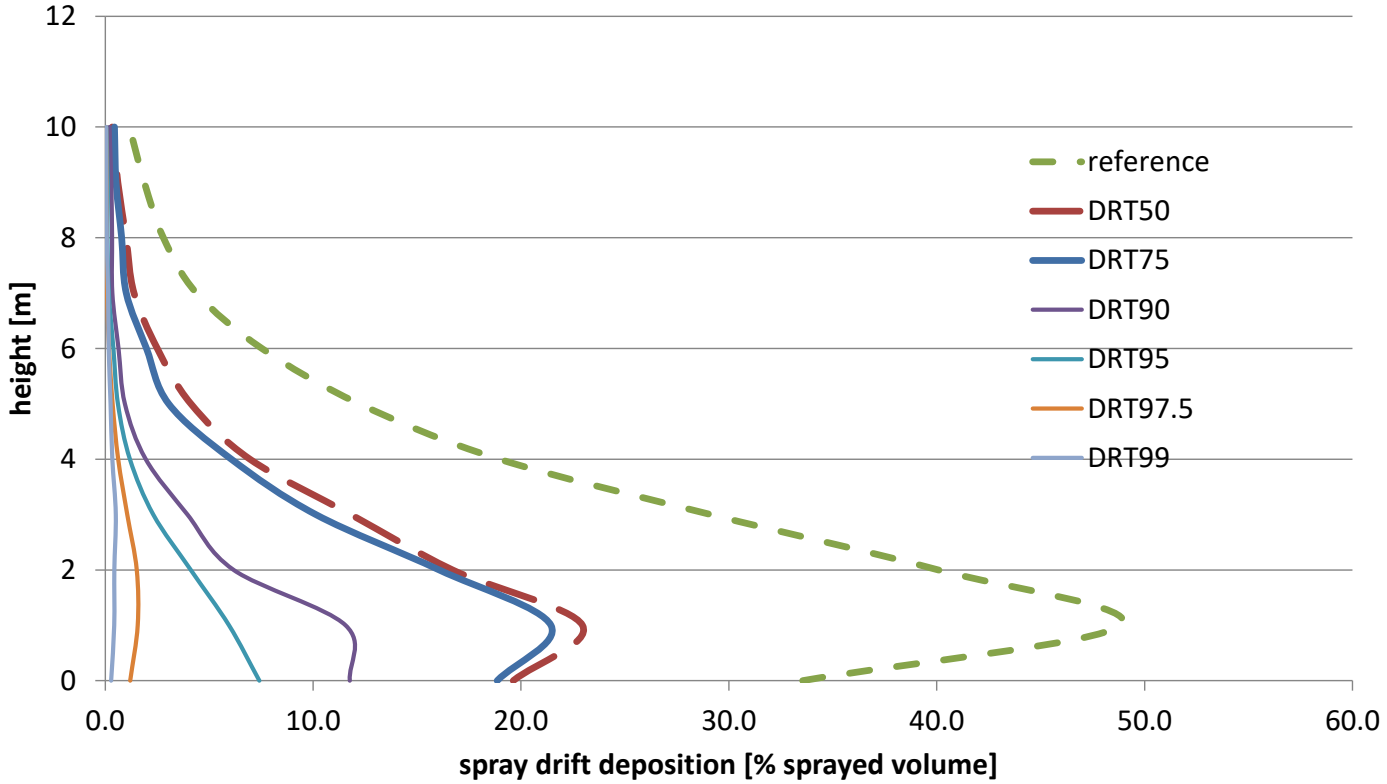
Airborne spray drift at 7.5 m distance from last tree row for DRT classes at dormant growth stage



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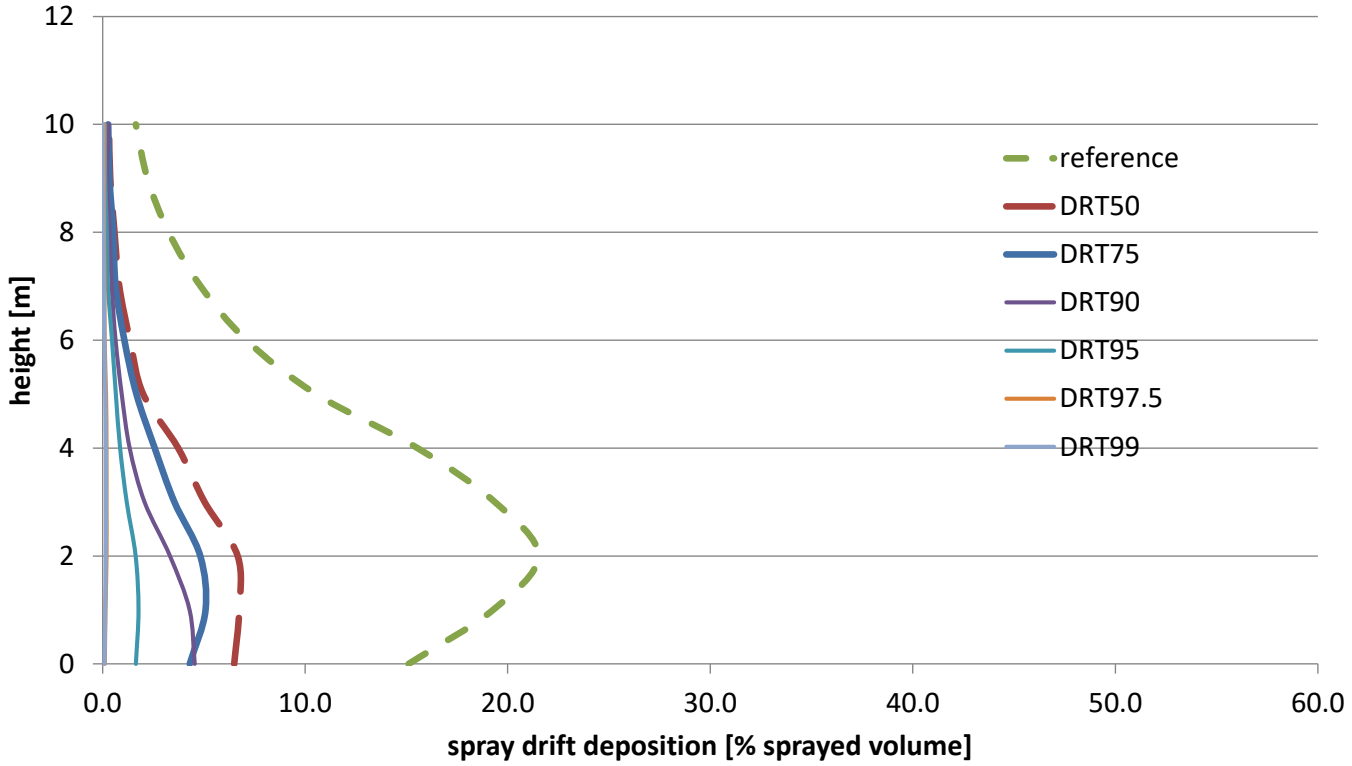
Airborne spray drift at 7.5 m distance from last tree row for DRT classes at full leaf growth stage



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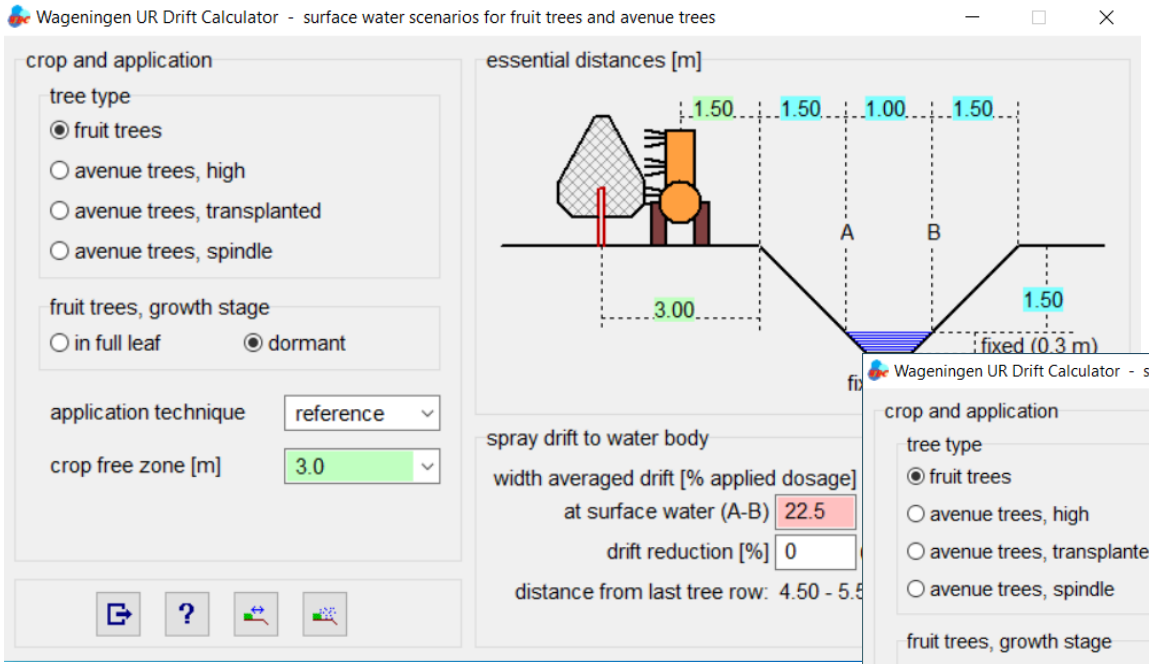
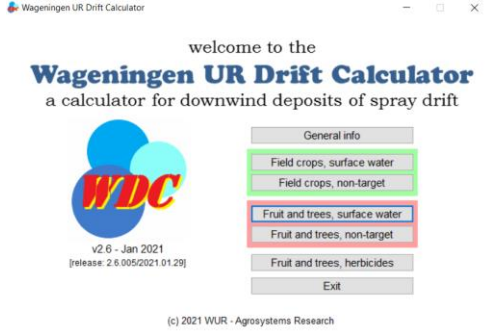
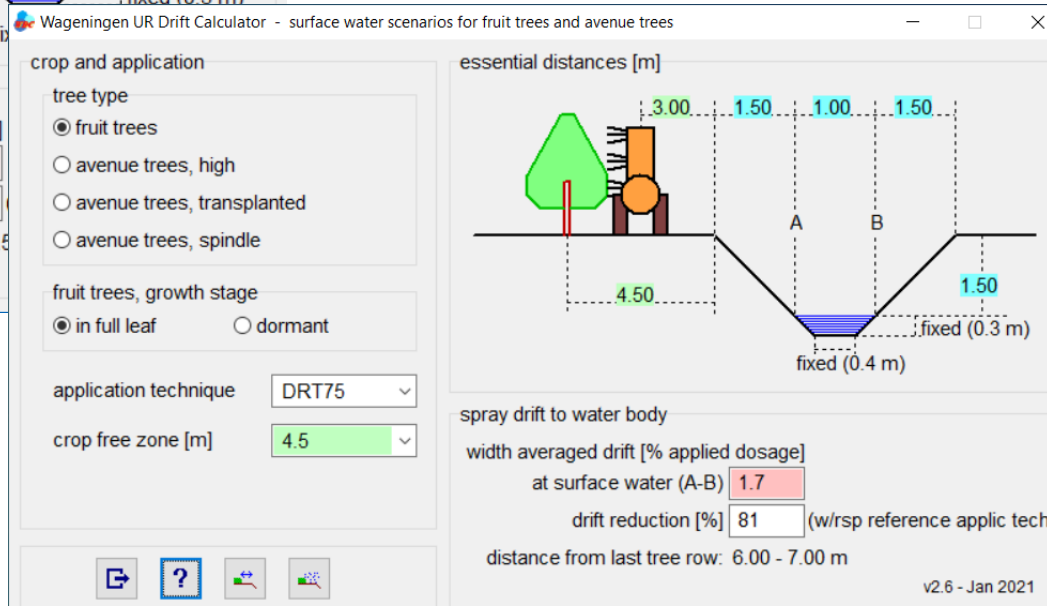
WageningenUR Drift Calculator (WDC)







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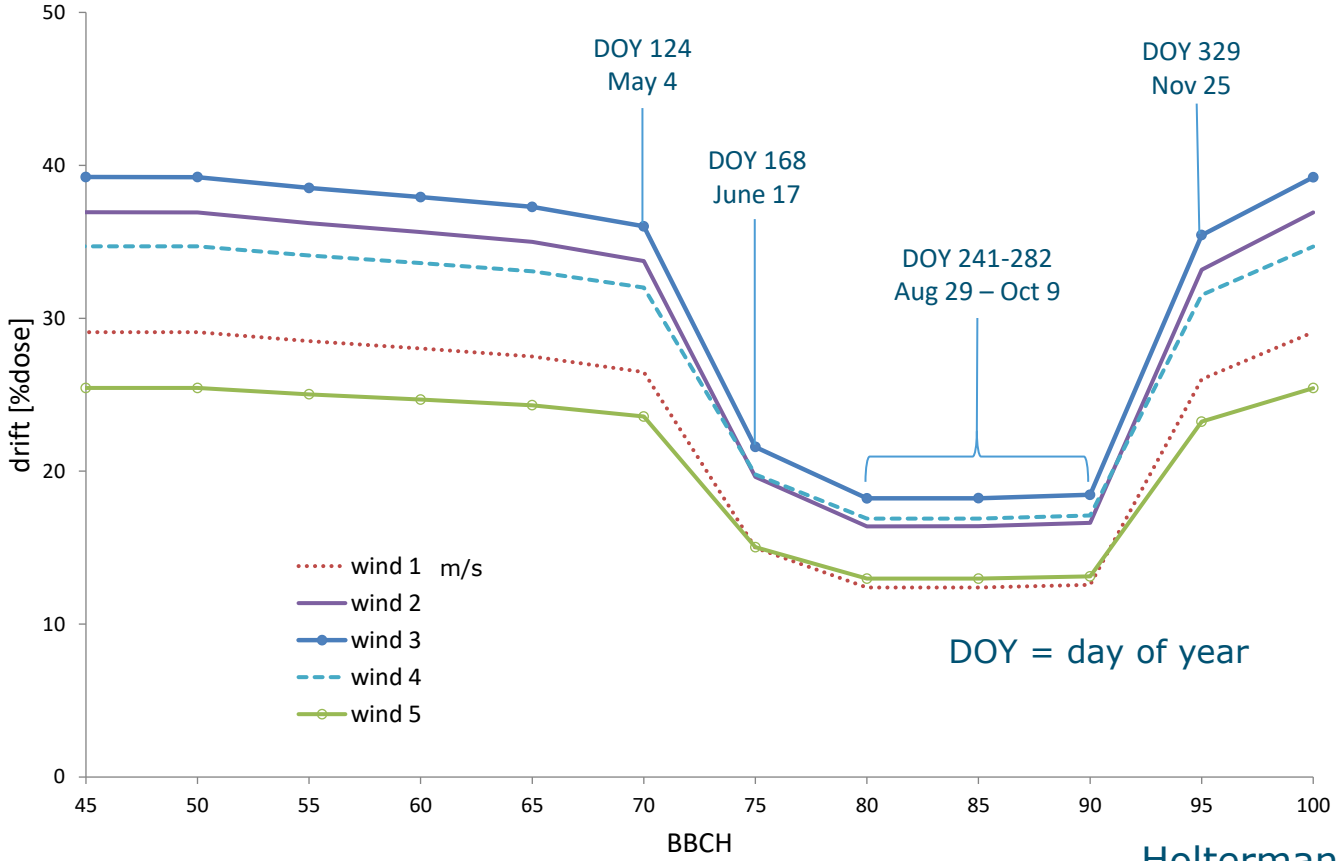
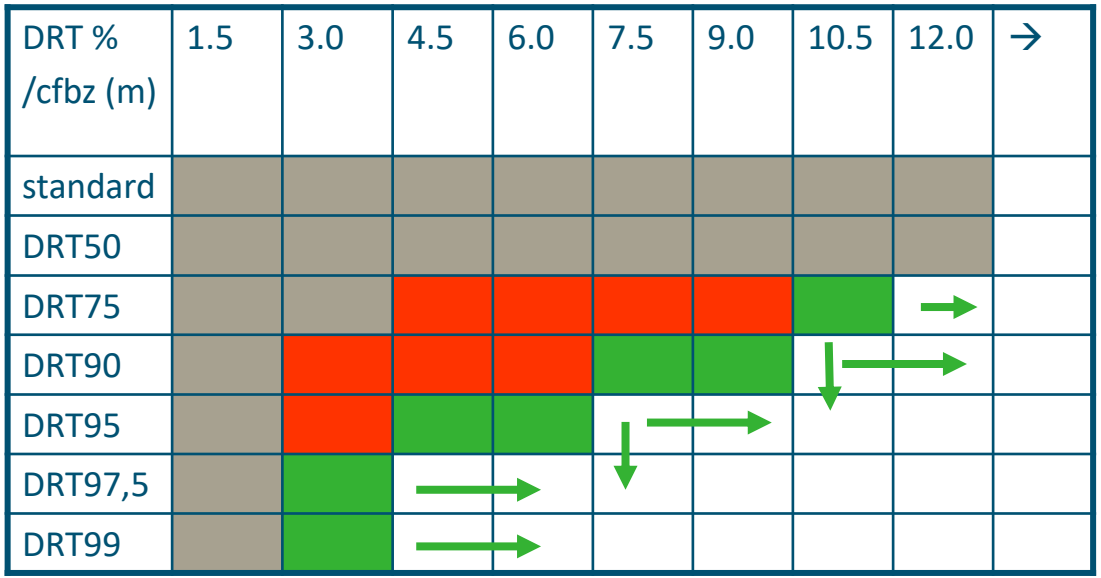
Fruit Drift Model SPEXUS example: deposits vs growth stage

at surface of watercourse (x=4–6 m), in cross wind, T=15°C



Holterman et al., 2017

Suggested matrix evaluation structure for PPP authorisation, which combination yes/no approved



Combination not authorised

Combination authorised

Combination not authorised, based on other legislation

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Spray drift from orchard applications

- Spray drift figures in NL authorisation procedure:
  - Reference: > 1st May 12%; < 1st May 23%;
  - DRT75 + 4.5 m buffer: > 1st May 1.7%;< 1st May 8.7%.
- (re-) registration of PPP will be more difficult.
  - Water quality and non-target organisms (>95% DRT).
- Measurements of water quality parameters.
- Residents and bystander exposure.
- Need for increased emission reduction
  - Improved spray deposition (=> lower dose rate)
  - Spray drift reduction

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New efficient spray technology - Spray deposition

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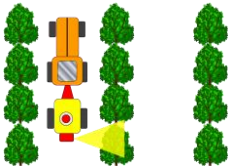
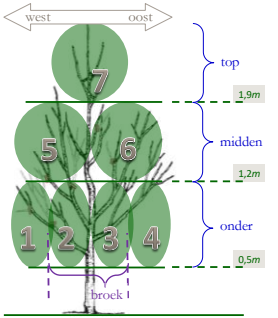
Spray deposition measurements

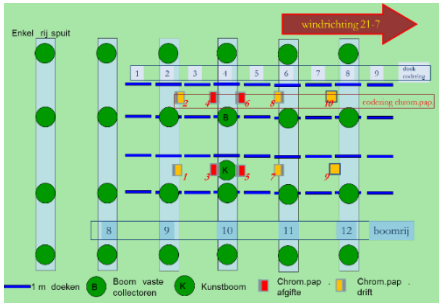
- Spraying one row of trees, both sides (Proeftuin Randwijk)
- Comparison with standard technique
- Fluorescent tracer used





- Sample leaves (7 tree sections) / 'branch-stem' collectors (dormant)
- Spray deposition at ground level (loss, emission)
- Control applied volume (vertical distribution – in front tree)

- Potential drift (vertical deposition in front of next tree rows)
- Labour intensive
- Analyses in WUR Spray Technology lab



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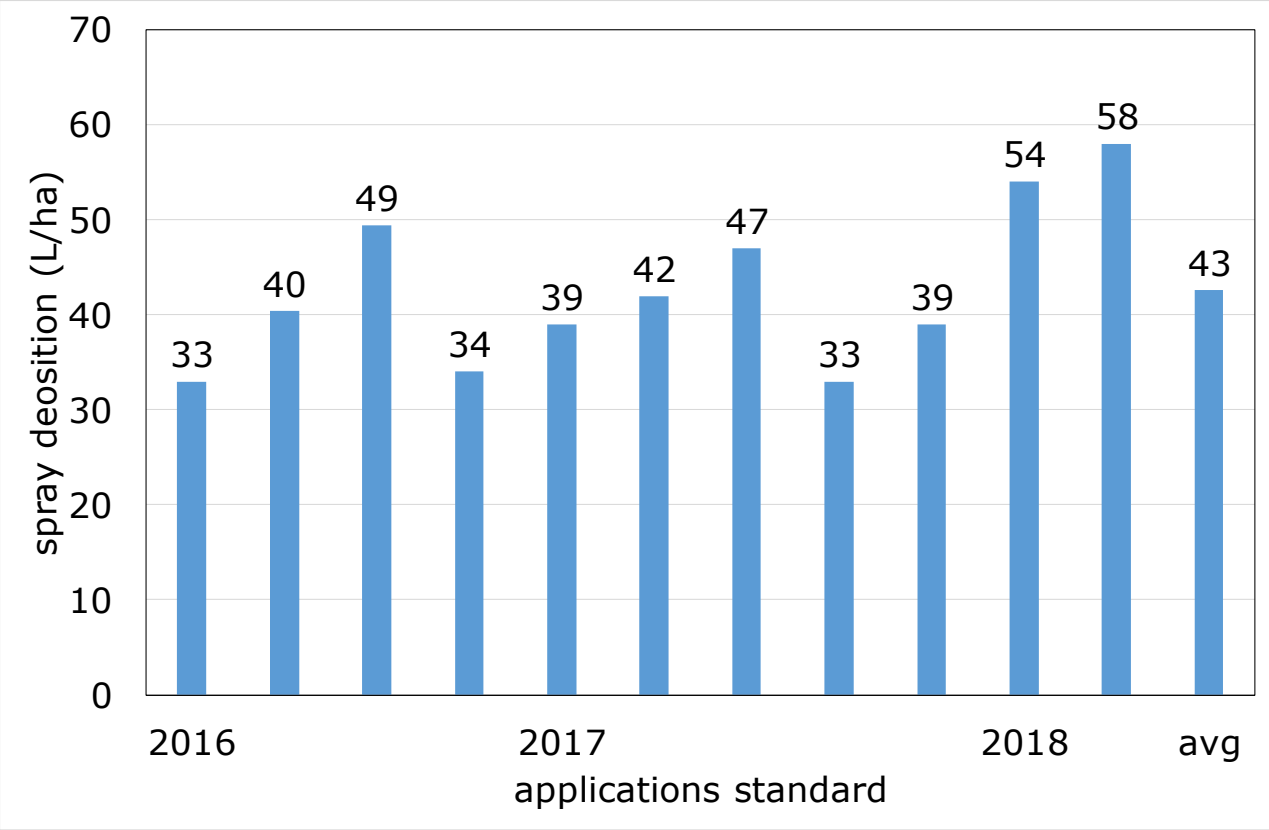
Spray deposition at leaves in tree canopy - standard (L/ha)

Spray volume 200 L/ha

With standard 33 – 58 L/ha deposition at leaves in tree canopy. That is on average 20% of applied spray volume.



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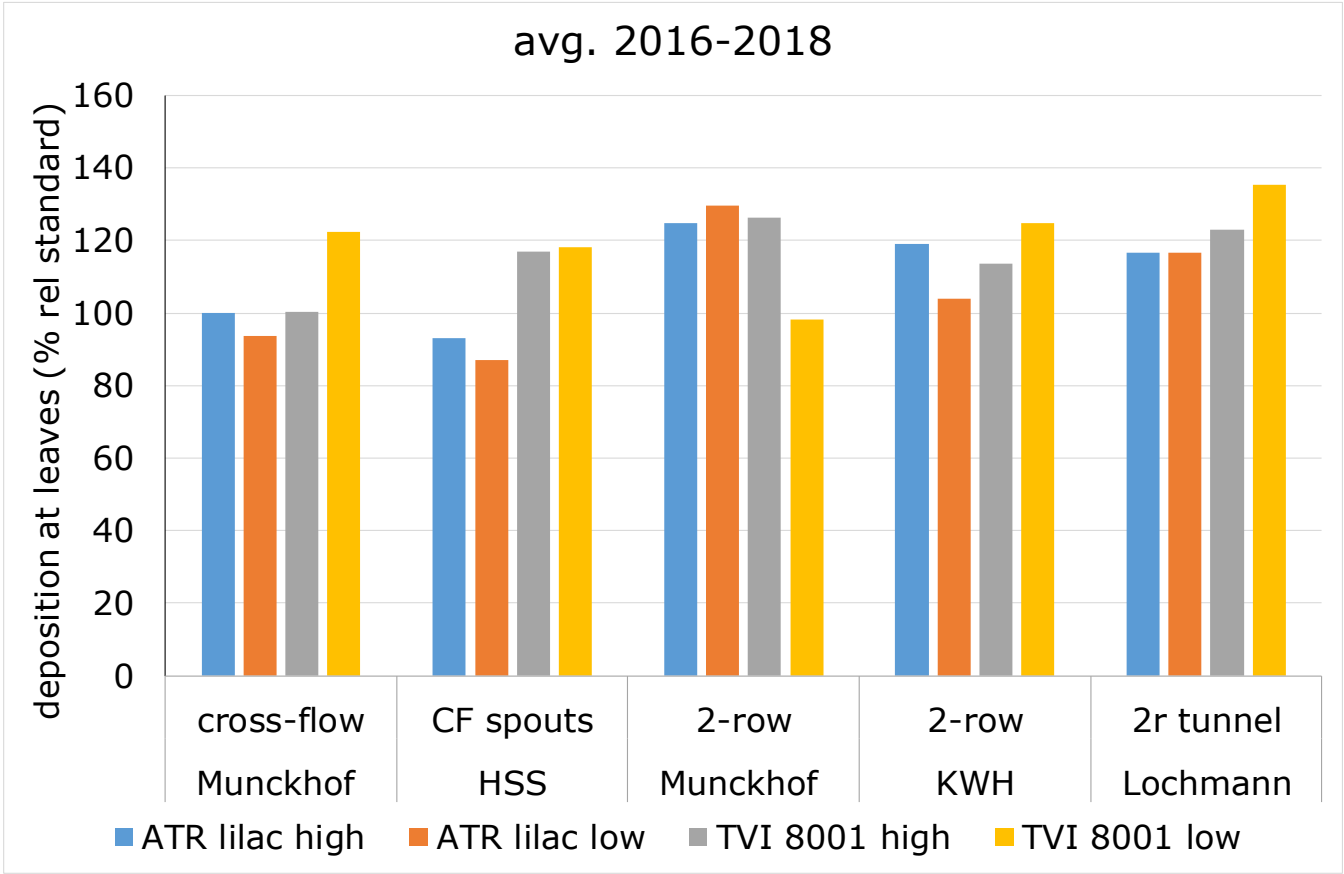
Spray deposition at leaves in tree – techniques

DRN90 (TVI) higher spray deposition

DRN90 + lower level air assistance - highest spray deposition (Munckhof 2-row?)

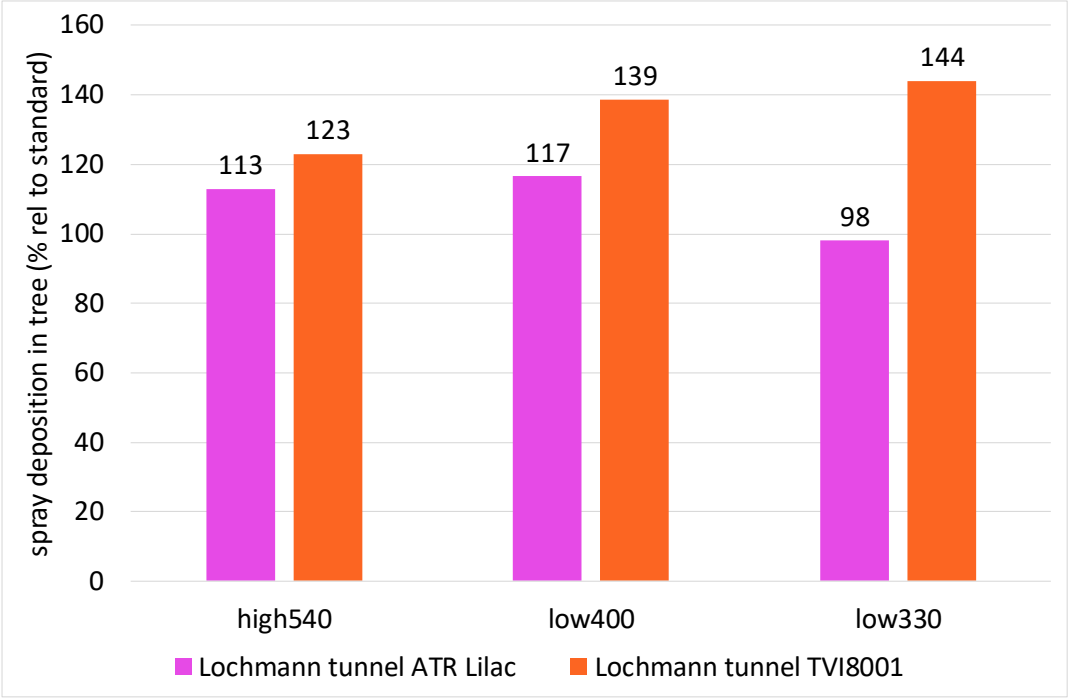


Spray deposition in tree Lochmann 2R tunnel– relative to standard sprayer

ATR lilac low air (400rpm)
max. +17%

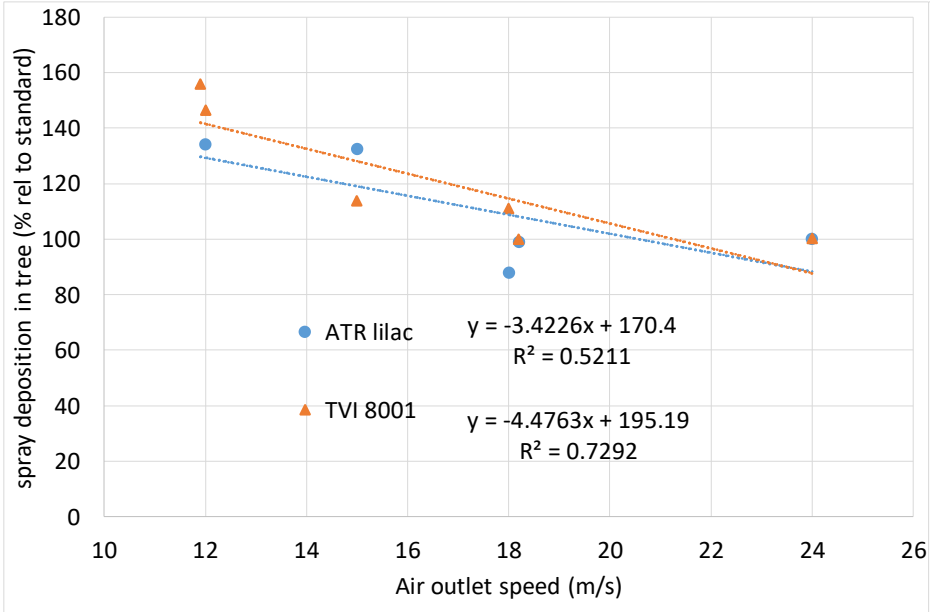
90% DRN full air
+23% increase

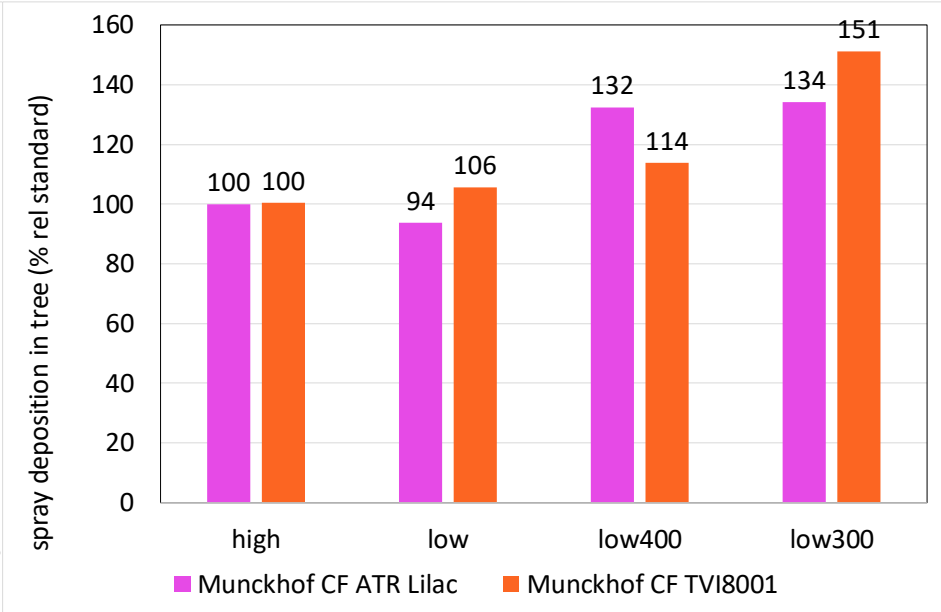
90% DRN low air (300rpm)
max. +44%



Standard orchard sprayer – effect nozzle + air ass.

- Spray deposition at leaves in the fruit tree:
  - 90% DRN full air +max. 17% increase rel to standard/reference
  - ATR lilac low air max. +34% ,, ,,
  - 90% DRN low air max. +51% ,, ,,





Spray deposition - general conclusions

- Spray deposition at leaves in tree canopy is only 15% - 50% of applied spray volume.
- In dormant/early growth stage trees spray deposition at stem and branches is 30%-50% of applied spray volume
- Rest is mainly on the ground in the orchard (20%-70%).
- All measured techniques can, with the right adjustments, increase spray deposition in the tree with 40%-60%
- A classification of increased spray deposition in the tree canopy is possible for sprayer types and its settings (steps of +10%)
- There is a relation between set level of air assistance and spray deposition at leaves in tree canopy possible for each machine.
- Techniques with highest spray deposition at leaves in the tree have in general highest spray drift reduction (DRT99) and lower fuel consumption.

Efficient application technology – spray deposition

- Depending on sprayer type and settings spray deposition at the leaves in the fruit tree canopy can be more than 50% higher
- increased spray deposition with tunnel and multiple row sprayers;
- Coarse spray quality venturi type nozzles (90% drift red.) increased spray deposition compared to Very Fine hollow cone nozzle types;
- Low air settings increased spray deposition in the tree canopy;
- Increased spray deposition opens the potential to reduce concentration as effective dose on target remains the same and therefor use reduction of PPP is possible

Classification of efficient application techniques?

- Reduced applied spray volume/dose:
  - Areas/bands yes/no sprayed
  - Task map – basis info
  - Efficient technique; higher deposition = Lower tank concentration? = Lower volume?
- Categorise techniques with reduced PPP input in classes - as with energy consumption labelling scheme

colour coding for increased spray deposition (%)	
standard	E
0-10	D
10-20	C
20-30	B
30-40	A
40-50	A+
50-60	A++

Next steps to be made

- Exchangeability of DRT classification within EU
- Setup a spray volume reduction technology classification (VRT) at EU level
- Quantification of precision application techniques in VRT classes
- Can we come to a generic risk reduction classification; Risk reduction factor (RRF) = f(DRT, efficient application technique, precision application technique, buffer zone, edge of field filter)
- Use of VRT classes in RRF and AS/PPP authorisation procedure

Thank you for your attention!

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Fruit crop spraying in The Netherlands